NETL

Office of Coal & Environmental Systems

Hydrogen Projects

An Integrated Hydrogen Production - Carbon Dioxide Capture Process from Fossil Fuels

Product Line: Coal Fuels and Hydrogen, Power Systems Advanced research, university coal research Program

Background/Description

The research effort of this project is to determine the feasibility of using char (from biomass and/or coal), ammonia, and carbon dioxide (CO_2) from power plant emissions to produce clean hydrogen and a sequestered carbon fertilizer. The overall concept involves a pyrolysis-reforming process that produces activated char and hydrogen from biomass and/or coal. A part of the hydrogen produced may be converted to ammonia. The activated char, and ammonia,may be allowed to react with CO_2 emissions to produce ammonium bicarbonate (NH_4HCO_3) , which is solidified within the pores of the char. This ammonium bicarbonate impregnated char, the final product of this effort, may be used as a slow release fertilizer. Thus the overall process yields hydrogen from the pyrolysis-reforming of biomass/coal and a char-NH_4HCO_3 fertilizer from CO_2 capture.

The work proposed would involve laboratory scale experiments and analytical development work in materials characterization. A small pilot reactor that produces hydrogen and char from biomass in a 50 kg/hr cross-flow pyrolysis-steam reforming system will be utilized for the coal and/or biomass pyrolysis-reforming studies. Extensive characterization of the pyrolysis char will be undertaken to ascertain the conditions that yield the most desirable char properties with respect to composition and physical properties such as size, surface area and pore size distribution. The CO_2 capture experimental setup would combine the char from the pyrolysis-reforming step with ammonia, water vapor and the equivalent (simulated) discharge of a coal fired power plant exhaust, using a 1kg/hr fluidized bed reactor to produce a high percentage ammonium bicarbonate nitrogen fertilizer within the char structure. The char-NH_4HCO_3 product would subsequently be characterized and evaluated in a greenhouse as a potential fertilizer.

Objective

The specific objectives of this project are to determine the processing conditions that will yield char with the desirable properties for CO_2 capture. This will be accomplished at bench-scale tests and at pilot-scale to verify, evaluate, and optimize conditions for the char-NH_3-CO_2 reaction to form solidified NH_4HCO_3 within the pores of activated char produced. Lastly, a study will be conducted to evaluate the properties of the char-NH_4HCO_3 product as a fertilizer in a green house environment.

Benefits:

The ability to convert char from coal and biomass into hydrogen and a slow release fertilizer will facilitate the use of hydrogen as a source of clean energy and sequester carbon dioxide at the same time.

Contact Information

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Other Participants
n/a

Planned Project Funding

DOE	$198,000
Non-DOE	$ 0
Total	$198,000

Period of Performance
Sep. 2003 to Sep. 2006

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Status as of December 2003

- Completed project planning, including tasks, assignments, and personnel.

Schedule:

FY 2004

- Project planning and initiation.
- Modifications of existing facilities and set up of experimental equipment.
- Operation of the pyrolyzer-reformer unit
- Testing, analysis, and characterization of char and other products
- Process optimization
- Test and evaluate the NH3-CO2 solidification reaction
- Pilot-scale tests
- Greenhouse studies to evaluate fertilizer usage
- Data analysis, preparation of final reports and presentations

Images/Diagrams